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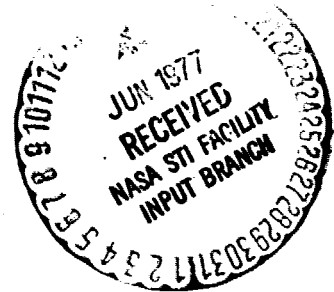
Contract NASW-2837
IITRI Project No. H6046 H31

(NASA-CR-153252) MARKET STUDY: TACTILE
PAGING SYSTEM (IIT Research Inst.) 16 p HC
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Market Study:
TACTILE PAGING SYSTEM

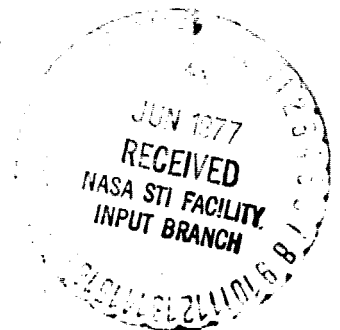


Prepared for:

National Aeronautics & Space Administration
Technology Utilization Office
Washington, D.C. 20546

Submitted by:

IIT Research Institute
Techno/Economic Studies Group
10 West 35th Street
Chicago, Illinois 60616



May 20, 1977

IIT RESEARCH INSTITUTE

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1. INTRODUCTION AND BACKGROUND

1.1 Introduction

This market survey was conducted by the Techno/Economic Studies Group at IIT Research Institute to develop findings relative to the commercialization potential and key market factors relevant to the Tactile Paging System for deaf-blind people. The system was developed by Dr. Frederick M. Kruger, Director of Research for the Helen Keller National Center for Deaf-Blind Youths and Adults, the Stanford Research Institute and NASA. The following discussion presents our findings on the nature and size of the potential market and the key factors effecting the commercial prospects for this device.

1.2 Background

Dr. Fred Kruger, Director of Research of the Helen Keller National Center for Deaf-Blind Youths and Adults in Sands Point, New York provided NASA with his concept for a tactile paging system. Stanford Research Institute had the appropriate technology which was originally developed under NASA contract for tactile feelers for unmanned vehicles, and was provided with NASA funds to apply the technology toward meeting the need for communication with deaf-blind people.

There are currently no patents on the system and no action has been taken to date. The antenna may represent a patentable feature and its ownership, if patented, would be with NASA.

The purpose of the tactile paging system is to communicate to the deaf-blind people in an institutional environment. The system consists of a main console and individual satellite wrist units. The console emits three signals by telemetry to the "wrist com" (receiving unit) which will measure approximately 2 x 4 x 3/4 inches and will be fastened to the wrist by a strap. Communication with these individuals is necessary both on a routine basis and during emergencies. For example,

the beginning and end of instructional classes necessitates attention on a regular basis and a fire alarm requires attention occasionally. The three vibration signals which can be emitted by the console to the wrist unit are "Fire Alarm," "Time Period Indication," and a third signal which will alert the wearer of the wrist com to the fact that the pin on the top of the wrist unit is emitting a Morse coded message. The Morse code message can be felt and recognized with the finger. The messages can be sent to individuals, to specific groups, or to the total wearer population at once. The console will be able to accommodate up to 256 wrist-coms and the price of the system is estimated to be approximately \$1,000 for the console and \$1,500 per wrist-com plus an installation cost of about \$300 to \$1,000 for an FCC licensed engineer. An estimated additional \$1,000 to \$2,000 annually will likely be spent for maintenance.

2. NATURE OF THE MARKET

2.1 Potential Users of the Tactile Paging System

The potential users of Dr. Kruger's Tactile Paging System are deaf-blind people in an institutional environment. Communication methods using the sense of touch can be effective for the deaf-blind. However, it should be noted that if the deaf-blind individuals are also profoundly retarded they will not have the ability to use and interpret the system. Currently, deaf-blind people do have a kinesthetic response to a tap or a stomp on the floor. The buddy system is used in case of emergency and those with some amount of residual sight can recognize blinking lights as a signal.

In the course of this study, we have learned that there are no national statistics available on deaf-blind people in general. Some data is available about the younger deaf-blind from 0 to 21 years old because they are enrolled in learning institutions whereas the adults are not. From our survey and information, we estimate that there are

between 10,000 and 15,000 deaf-blind people in the U.S. and that 5,000 of these people have been identified as being between 0 and 21 years of age. It is estimated that 75% to 90% of the deaf-blind of this age group have communications skill capabilities which are too primitive to permit use of the tactile paging system. Further, the children and youths are not located in sizable number in any one particular area or school but are widely distributed in the country. Occasionally up to 20 deaf-blind children are found in a given school for the deaf or a school for the blind. To repeat, there are a small number of deaf-blind children in one institution and a very small percentage of them that are capable of using the system. Further the number of deaf-blind children does not seem to be increasing as, for example, in Illinois where there are now 150 deaf-blind children, less than 10 babies a year are identified as deaf-blind.

Deaf-blind adults also are not centrally institutionalized to any great degree and are generally integrated with other people. The Helen Keller National Center for the Deaf-Blind Youths and Adults is the exception where 35 people from age 18 and up are currently enrolled and up to 50 can be accommodated there. The clients at the Helen Keller Center are fairly intelligent and for the most part do have the communication skills needed to use the tactile paging system. It would work well there, fit the Center's needs, and add to communication capabilities.

The potential users of such a system generally could not afford to pay such a high price for the system. State, federal or private funding would have to be appropriated to pay for this system, and for very small numbers of deaf-blind people, the system is not cost justifiable as one-to-one communication could take its place.

3. COMPETITIVE ENVIRONMENT

In order for blind people to know the time, watches are sold by the American Foundation for the blind for \$33.50 and up. (See Appendix for product information). There are a few different models but they all have crystals that flip up with the push of a button revealing numerals and braille dots. Deaf-blind people without serious communication skill deficiencies can learn to read the time periodically.

Motorola and Bell & Howell (see Appendix for product literature) both sell vibrating pagers which are currently used mainly by doctors, lawyers, and construction workers who do not want to be disturbed by a beeping noise or who work in high noise level situations and would not hear a tone. The vibrating pagers clip on to the belt and alert the wearer of impending messages by a vibrating code. The wearer then calls to find out what the message is. A radio common carrier as opposed to a main console sends out the vibrating message on the Motorola and the Bell & Howell vibrating paging system. The Motorola pager sells for \$298 and approximately \$8 a month is the cost of air time. It emits only one vibration signal but has two lights so the wearer can see which of the two parties was paging him. The Bell & Howell system costs \$300 per pager and the estimate that it would cost approximately \$800 for the system to be made for in-house use (having a captive transmitting console). It would take considerable engineering development to have two different vibrations on one pager. If two different vibrations could be sent out the second could alert the client to go to an information center and receive a personal message.

4. MARKET SIZE

As we see it, the overall market is essentially for one specialized system which is for the Helen Keller National Center for deaf-blind adults. There are not enough deaf-blind people congregated in any other particular area to justify the cost of the system. We estimate at least a dozen people would need to be using the system to justify the expense. At the Helen Keller Center one console and approximately 50 receivers could be used which would cost a total of about \$75,000. Besides the small market and the high price of the system, another major barrier to market entry would be licensing required by the FCC for transmitting facilities.

5. SUMMARY

As the market for this system is essentially limited to probably one major institution, commercialization of this technology, if it occurs, would be only under special order to a producer from the user and buyer. Clearly, industries would not pursue this product on their own because of this severe market limitation. If NASA and the Helen Keller National Center wish to have such a system developed and implemented, it is advisable that they approach Motorola or Bell & Howell to probe their interests in filling this special order. Since these two firms are presently producing vibrating paging systems, they would seem to be well qualified to pursue this task.

6. INTERESTED PARTIES

The following people have expressed an interest in keeping abreast of further developments of the tactile paging system.

Dr. William Plotkin
Chicago Hearing Society
178 West Randolph
Chicago, Illinois 60601

Mr. Michael Reynolds
Manager, New Products Planning
1889 Page Mill Road
Palo Alto, California 94304

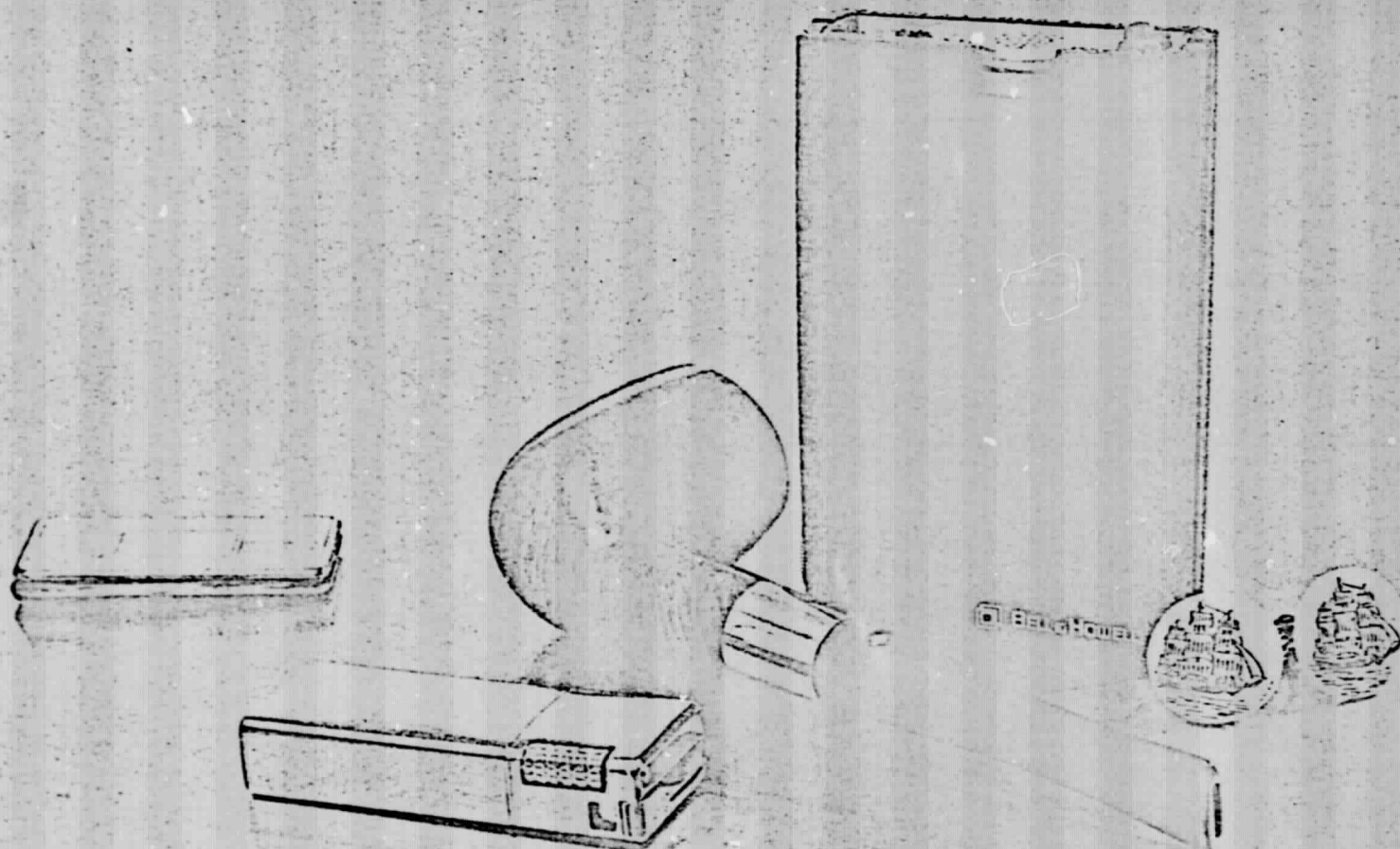
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APPENDIX A

PRODUCT LITERATURE

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BELL & HOWELL'S TONE/VIBRATION PAGER

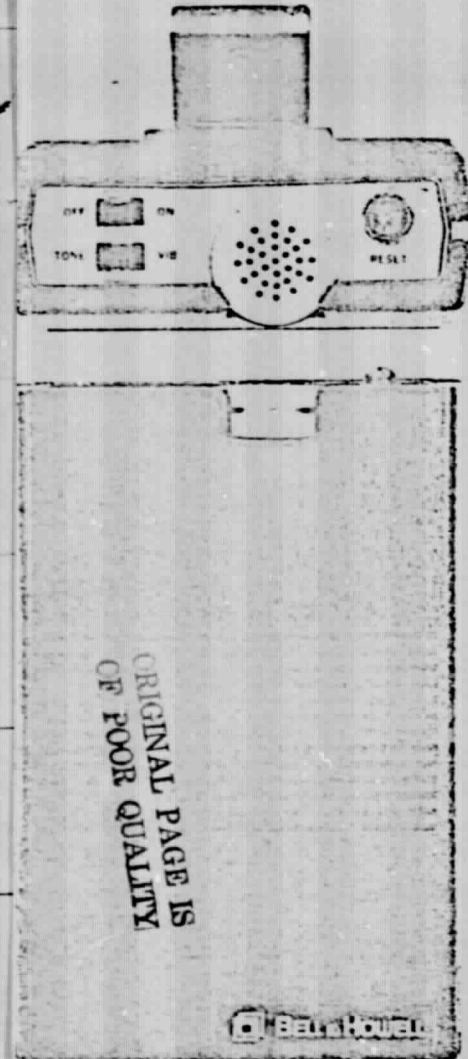
In LoBand, HiBand or UHF, it's the world's most polite pager. Operating on a long-life Mercury or rechargeable NiCad battery, it signals silently, so it never embarrasses you or disturbs those around you. For doctors, lawyers, executives, funeral directors, librarians and others who prefer discrete signalling, it's ideal. In high-noise industrial areas where audible paging systems fail, it gets the message through, every time. It operates on long-life Mercury or rechargeable NiCad batteries.

Whether you're an individual user or system operator, you should explore silent paging. It's the future of the paging industry.

SPECIFICATIONS

Model Number	* VSP 31	* VSP 41	VSP 415	VSP 460	VSP 490
FM Frequency Range (MHz)	30-50	145-174	405-420	450-475	475-512
Size	1" x 2 ³ / ₈ " x 3 ³ / ₄ " plus clip				
Weight	7.1 ozs. plus battery				
Battery Type	Mercury TR133 (4.2V) or NiCad 3-cell Type 1 (3.75V)				
Battery Life	Mercury 300-350 hrs.; NiCad 50-60 hrs. per charge				
Shock and Vibration Resistance	Meets EIA specification RS 316				
Decoder Type	2 tone sequential, 2 second call rate				
Decoder Frequency Range	275-2000 Hz				
System Compatability	Any 2 tone sequential system within the decoder call rate and frequency range.				
Paging Signal	Switched,user choice of intermittent tone or pulsed vibrations.				
Frequency Stability	$\pm .0025\%$ (-30°C to +60°C)		$\pm .0005\%$ (-10°C to +50°C)		
Selectivity	50 db@ 30 KHz		45db @ 25KHz		
Spurious and Image Rejection	>50db		>45db		
Paging Sensitivity					
Field:	< 3 μ V/m		< 15 μ V/m		
Chassis:	< .12 μ V		< .15 μ V		
Available Accessories	H-14 Earphone, B-34 Battery Charger				
Reset	Manual switch with automatic time-out after 20 seconds in vibration mode.				

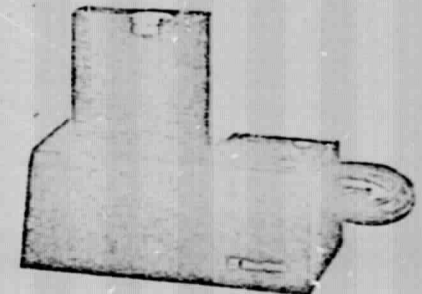
Note: The above models can be supplied with decoder time constant adjusted to accommodate 5-second call rate systems having a 0.25 second gap between first and second tones.



actual size

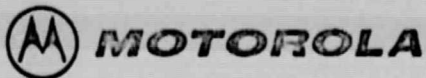
B-34 CHARGER.

In your home or office, this compact 110V unit charges your pager and a replacement NiCad battery simultaneously. Pager may be charged while ON or OFF; it receives pages and functions normally in the latter position.



BELL & HOWELL
COMMUNICATIONS COMPANY

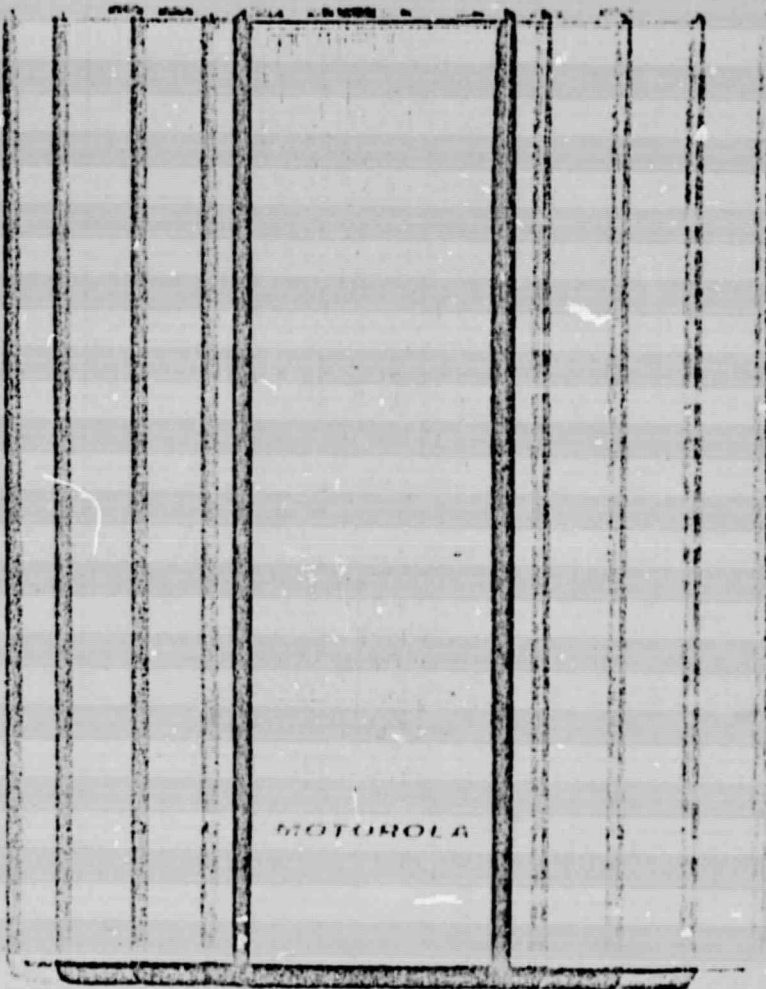
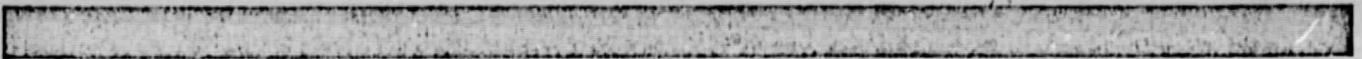
78 Blanchard Road, Burlington, Mass. 01803
(617) 273-1210



PAGEBOY II

VIBRA-PAGE Vibrating/Tone FM Radio Pager

33-37 MHz
41-50 MHz
148-174 MHz
450-512 MHz



- Vibrating Alert
- Tone Alert
- All Solid-State Reliability
- Positive Alerting
- Optional Battery Saver Module
- Optional Sub-audible Paging Ability
- Field Addable Options
- Two Year Guarantee

Now you can have vibrating or tone alert in the small lightweight Pageboy II shirt pocket pager. You may select either mode of alert.

Advanced solid state electronics in the Pageboy II pager, combines state-of-the-art performance and reliability with small size and light weight.

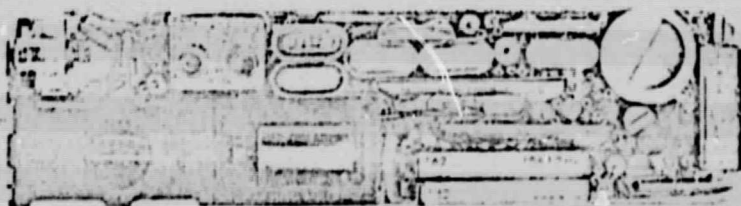
Features • Benefits

ALERT SELECTION

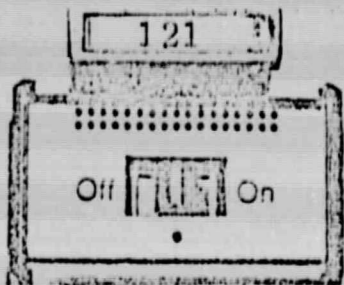
The mode of alert may be selected to fit the circumstances. When the pager's three position switch is in the "ON" position, the pager will emit a pulsating alert tone when paged. Sliding the switch to the center "•" position causes the pager to vibrate silently when the pager is signalled.

VIBRATING ALERT

Now you can be paged in quiet places without disturbing anyone, or in noisy environments where an alert tone might not be heard. The vibrating alert received when your pager is in the vibrate select mode will be automatically reset



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in ten seconds. Or, you may manually reset at any time by depressing the switch.

TONE ALERT

An audible alert tone is available when desired. A loud pulsating alert tone of 80 dB sound pressure level at 12 inches will be generated by your pager if it is signalled while set for tone alert. This audible tone will reset itself in ten seconds unless manually reset earlier by depressing the switch.

MINIATURIZED

Motorola's Pageboy II tone-only radio pager makes extensive use of hybrid integrated circuit technology to reduce size. This small size and lightweight design allow it to be worn neatly alongside your pen and pencil set. You'll never know you're wearing it until you're paged!

POSITIVE ALERTING

With either vibrating or tone alert, the high selectivity of the Pageboy II pager and excellent receiver sensitivity help the page get through. • No matter where you are in the wide coverage area — office, plant, car or home — the Pageboy II tone-only radio pager is sure to reach out and alert you.

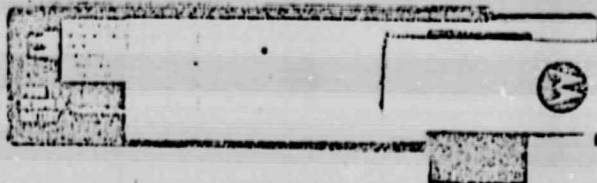
SOLID STATE RELIABILITY

Highly reliable monolithic integrated circuits in conjunction with thick and thin film techniques permit the use of hybrid modules, eliminating 130 conventional components. Solid-state Permacode active filters eliminate mechanical contacts. A shock isolation system separates the sturdy fiberglass circuit board from the high impact plastic housing. • High performance and reliability are the results of this design. Excellent shock protection makes your pager insensitive to shock falsing or damage. Dependable, plug-in active filters permit code changing in a matter of seconds.

SERVICEABILITY

Using modular construction, all circuitry is contained on a single printed circuit board

which pops in and out of the housing. A special key is used to completely remove the cover for easy access to the pager's electronics. • With no screws or cumbersome wires to disconnect, servicing is easier and trouble shooting is faster. The special "safety latch" deters the curious from removing the cover.



SIMPLIFIED BATTERY REPLACEMENT

The cover of the Pageboy II tone-only radio pager can be slid partially open to expose the battery. The user then lifts the battery compartment tab and removes the old battery. • Your battery can be quickly replaced without the need for special tools. In a matter of seconds, you're back on the air.

TWO YEAR GUARANTEE

The Pageboy II tone-only radio pager represents the latest state-of-the-art design techniques. Its reliability and ruggedness are backed by Motorola with a two year guarantee on all parts, with the exception of the battery. • The advantages of this advanced design are reflected in lower per-month maintenance costs. Our guarantee sums up the achievements gained in this high quality receiver.

Options • Benefits

BATTERY SAVER

The optional battery saver module is an electronic switch that powers the receiver once every 1500 milliseconds for a short sampling period. • Extend the life of your battery to over 10 weeks (435 hours) in your vibrating/tone alert pager. With only minor system modifications, this option provides battery life two and a half times longer than standard.

SUB-AUDIBLE PAGING

Using sub-audible code tones, this optional module permits the pager to be signalled at the same time the channel is being used by two-way users. • With this option, up to 870 additional pagers can be put on your radio channel without interference. For common carrier applications, this results in more revenue from the channel.

PAGEBOY II Vibrating/Tone Radio Pager

Guaranteed Performance Specifications

	LOW BAND VHF	HIGH BAND VHF	UHF
Models:	A01CAC1468_A with R032; standard coding A01CAC1368_A with R032; sub-audible coding	AC3CAC1468_A with R032; standard coding A03CAC1368_A with R032; sub-audible coding	A04CAQ1468_A with R032; standard coding A04CAC1368_A with R032; sub-audible coding
Frequency:	33-37 MHz; 41-50 MHz	148-174 MHz	450-512 MHz
Size Without Clip:	4.81 x 1.38 x .81 inches; (122 x 35 x 21 mm) 5.35 cubic inches	4.5 x 1.38 x .81 inches; (114 x 35 x 21 mm) 5.03 cubic inches	4.81 x 1.38 x .81 inches; (122 x 35 x 21 mm) 5.35 cubic inches
Weight Without Battery:	3.83 ounces (109g)	3.59 ounces (102g)	4.03 ounces (114g)
Weight With Battery:	4.26 ounces (121g)	4.01 ounces (114g)	4.46 ounces (127g)
Field Strength Sensitivity:	8 μ V/m paging (8 position average)	4 μ V/m paging (8 position average)	15 μ V/m paging (8 position average)
Adjacent Channel Selectivity:	-60 dB at $\pm$ 20 kHz	-60 dB at $\pm$ 30 kHz	-50 dB at $\pm$ 25 kHz
Spurious and Image Rejection:	-60 dB	-60 dB	-40 dB
Frequency Stability: (from -10°C to +50°C, 25°C ref):	$\pm$ 0.0020%	$\pm$ 0.0020%	$\pm$ 0.005%
Alert Tone Output:	80 dB minimum, sound pressure level at 12 inches.		
Alert Tone Frequency:	2000 Hz		
Power Consumption:	4.3 mA (standby); 70 mA (alert tone); 180 mA (vibrate) at 1.3V dc supply voltage.		
Battery Complement:	One (1) "N" cell mercury battery (Mallory MP401) NOTE: Vibrating/tone alert models are <u>not</u> available with rechargeable batteries or "AA" size batteries.		
Battery Life in Hours: (continuous operation)	With Battery Saver*: 435 hours Without Battery Saver: 175 hours *Battery Saver option not compatible with subaudible coded pagers.		
Minimum System Call Time: (per call)	Without Battery Saver With Battery Saver	Normal Coding 2.5 sec. 3.0 sec.*	Sub-Audible Coding 7.0 sec. non-compatible
	*Battery saver operation requires lengthening Tone A (in the encoder) from .4 to 2.7 sec. Tone B & Interpage gap timing remain the same as in non-battery saver operation. (PAGEBOY and PAGEBOY II pagers without battery saver will operate compatibly in systems having battery saver timing).		
System Call Capacity:	Normal coding: 3540 codes; 60 tones Sub-Audible Coding: 870 codes; 30 tones		
System Modulation:	Normal Coding: 3.3 kHz Sub-Audible Coding: 0.5 to 1.0 kHz		



MOTOROLA
Communications and Electronics Inc.

A Subsidiary of Motorola, Inc.
1301 E. Algonquin Road, Schaumburg, Illinois 60172 • (312) 397-1000

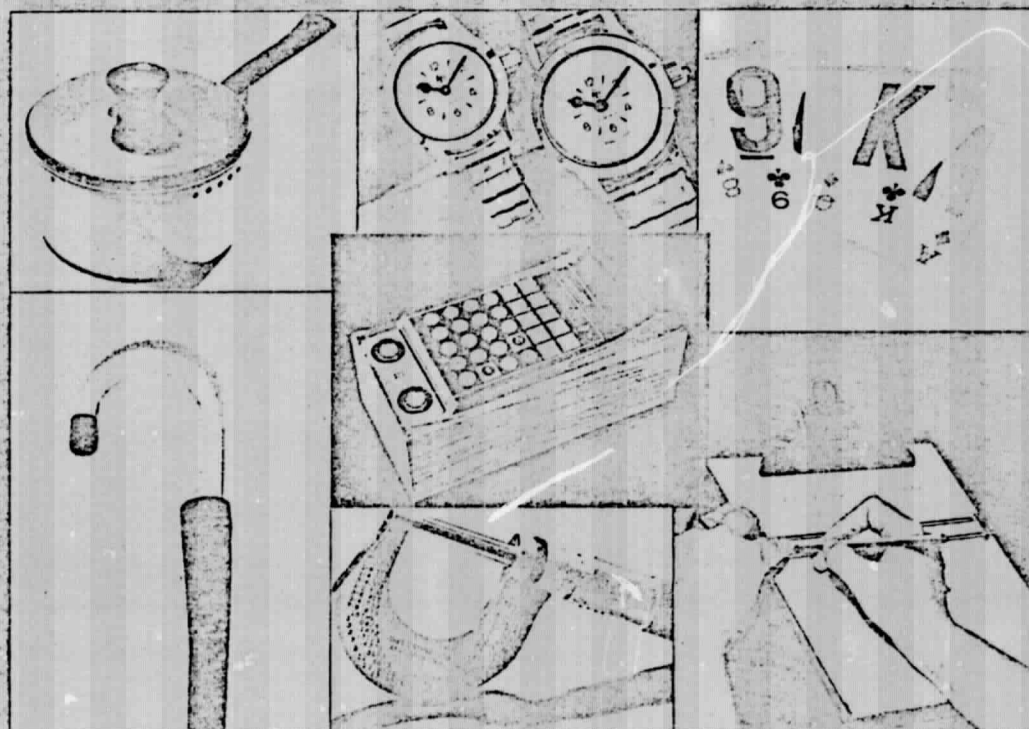
Motorola guarantees that this equipment, at the time of proper installation, will meet or exceed the performance specifications listed above.

■ Specifications subject to change without notice.
■ Motorola, Pageboy, Vibra-Page and Permacode are trademarks of Motorola, Inc. (758) GSI

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AIDS & APPLIANCES FOR THE BLIND & VISUALLY IMPAIRED



22ND EDITION 1976-77 / AMERICAN FOUNDATION FOR THE BLIND

WATCHES, CLOCKS, & TIMERS

AFB WATCHES

These watches are designed especially for AFB, and are imported from Switzerland. AFB watch dials (except the diamond presentation pieces) are in both braille and inkprint. The braille portion has three raised dots at 12, and double raised dots at 3, 6, and 9. A single raised dot appears at each remaining hour. The three raised dots at 12 on men's wrist and pocket watches are positioned in a straight line on an axis running toward the center of the dial. On women's watches the raised dots at 12 are in a triangular formation. The inkprint portion of the dial shows Arabic numerals at the even hours, with triangular indices at the odd hours. The spring cover button is at 3 o'clock with in the winding stem.

Guarantee: Before a watch is shipped to a customer, it is thoroughly checked and tested for accuracy; we ship watches in perfect condition. Each AFB watch carries the following guarantee: The mainspring and balance staff are covered unconditionally for the lifetime of the watch. All other parts are guaranteed for life against defects in material and workmanship, providing the watch has received only normal use and been given adequate care. Defective parts will be replaced free of charge if the watch is returned to AFB along with the Certificate of Guarantee.

Important: The guarantee does not cover the following because these are not "defects" but result from use: Replacement of winding stems and crowns, damage to watch case, crystal or dial caused by conditions beyond our control, damage from rust or corrosion.

Also, the guarantee does not cover cleaning and re-oiling of the movement. This is because the lid of a braille watch

is frequently opened, possibly allowing dust and foreign particles to enter the movement. Periodic cleaning and oiling may therefore be necessary. Fingers should be as clean as possible when using the watch to minimize the risk of dirt entering.

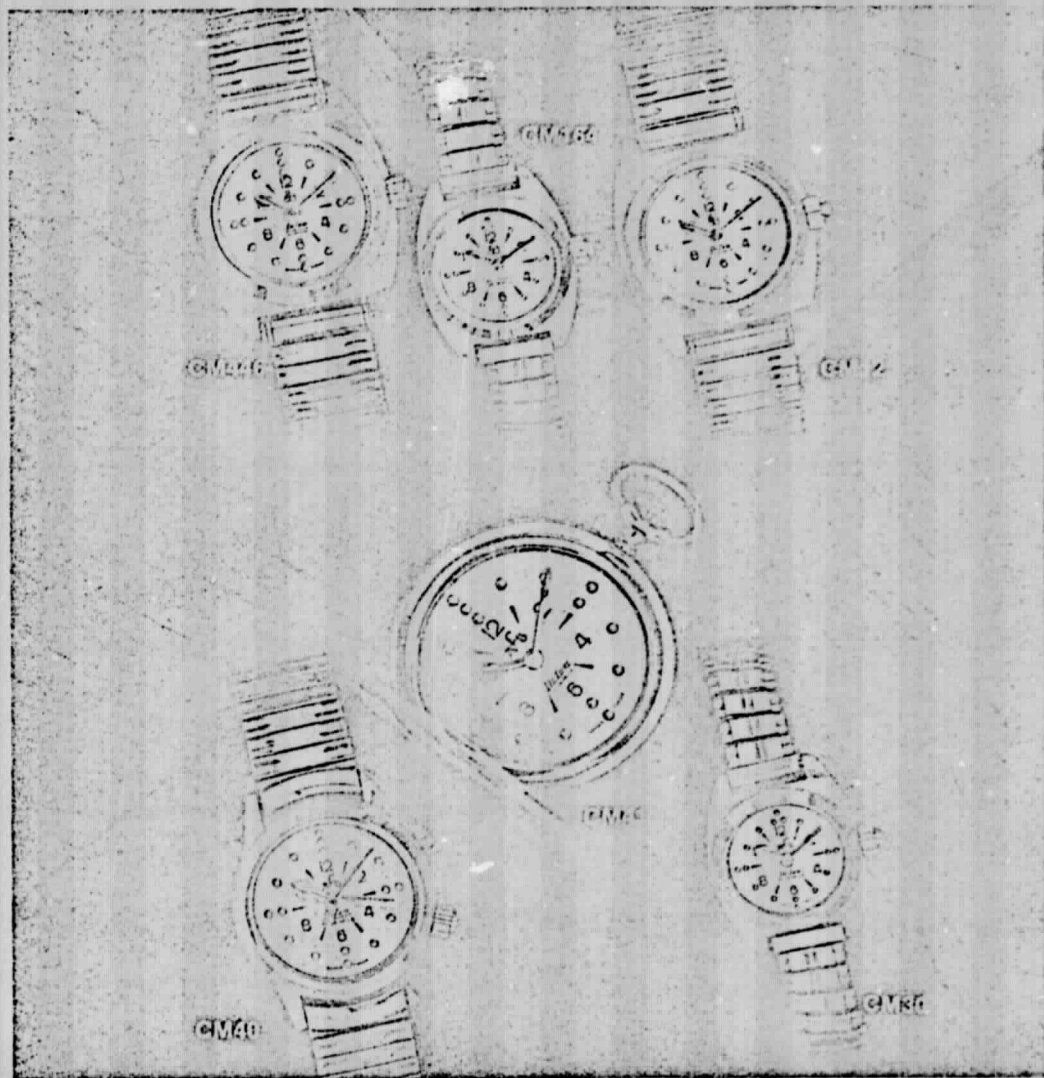
It is very important when closing an AFB watch to depress the spring cover button. Otherwise, the constant "snapping" will cause the spring cover to wear out and make it impossible to keep the lid closed.

Your AFB watch will give long and good service providing it is, like all precision instruments, treated with the care it deserves.

Repairs: Routine servicing, such as cleaning or regulation, can be carried out by your local watch repairer. If he is unable to make necessary repairs, the watch should be returned to: American Foundation for the Blind, Inc., 20 West 17th Street, New York, N.Y. 10011. If the watch is still under guarantee, please remember to include the Certificate of Guarantee. Whenever you have to return a watch, whether it is under guarantee or not, also send a letter with it explaining the nature of the problem. This information helps us to give you the best service. No repairs will be carried out without your first approving our estimate.

Should you have a Gotham or Bennett Brothers watch that needs repair, and which was originally supplied by the AFB, you may also send it to the above address.

You may charge watch repairs to your American Express, BankAmericard, or Master Charge card. Instructions for charging will be given when we send you an estimate. No other charge accounts will be accepted.



AFB Deluxe Watches

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The AFB Standard watch comes with a 17-jewel, shock-resistant, Swiss movement, which has an anti-magnetic hairspring and unbreakable mainspring and balance staff. The watch has a white Duco dial. The spring cover button is at 3 o'clock within the winding stem. Weight: 8 oz.

Men's Wrist Watch

Chrome plated with stainless steel expansion band. 17-jewel movement @
CM50—\$33.50

Men's Automatic Wrist Watch

Self-winding. Chrome plated with stainless steel expansion band. 17-jewel movement @
CM51—\$44.50

Men's Pocket Watch

Chrome plated with 17-jewel movement @
CM52—\$33.50

Men's Pocket Watch

Like CM52 above, but in gold electroplate @
CM53—\$37.50

Women's Wrist Watch

Chrome plated with stainless steel expansion band. 17-jewel movement @
CM54—\$33.50

AFB DELUXE WATCHES

AFB Deluxe watches, available in many models, have "Tonneau" shaped cases with modern dials displaying the AFB monogram. A 17-jewel Incabloc (shock resistant) Swiss movement contains an anti-magnetic hairspring, and an unbreakable mainspring and balance

automatic watches have 21-jewel movements. 14K automatics have 25 jewels.

Deluxe goldplated watches have bright gilt (gold tone) Sunray brushed finish dials and high quality gold filled expansion bands.

14-karat gold and Deluxe chrome watches have bright silver Sunray brushed finish dials and high quality stainless steel expansion bands. The spring cover button is located within the stem at 3 o'clock.

All Men's Deluxe watches are fitted with the well-known Kreisler Dura-Flex expansion band.

AFB deluxe watches are attractively gift boxed. Weight: 8 oz.

Women's Models

Women's Deluxe gold electroplated wrist watch @
CM30—\$47.95

Women's Deluxe chrome plated wrist watch @
CM157—\$41.95

Women's 14 Karat gold wrist watch, 21-jewel movement. @
CM32—\$199.95

Women's 14 Karat gold automatic (self-winding) wrist watch, 25-jewel movement. @
CM164—\$204.95

Women's Deluxe gold electroplated automatic (self-winding) wrist watch. @
CM238—\$58.95

Men's Models

Men's Deluxe gold electroplated wrist watch.
CM12—\$46.95

Men's 14-Karat gold wrist watch, 21-jewel movement @
CM453—\$245.95

Men's Deluxe chrome plated wrist watch @
CM99—\$38.95

Men's 14-Karat gold automatic (self winding) wrist watch, 25-jewel movement. @
CM408—\$299.95

Men's Deluxe gold electroplated automatic (self winding) wrist watch @
CM446—\$58.95

Men's Deluxe gold electroplated ALARM wrist watch. Winding crown and spring cover button located in the stem at 4 o'clock; alarm setting crown located at 2 o'clock. Round case @
CM40—\$74.95

chrome, machine-turned hunting case. @
CM41—\$37.95

Men's Deluxe pocket watch. Same as CM41, except the case is gold electroplated. @
CM42—\$48.95

DIAMOND DIAL WATCHES

These beautiful 14-Karat gold watches are imported by AFB from Switzerland, and have the same deluxe movements as the 14-Karat gold watches described previously.

The dials are brushed silver sunray with diamonds, instead of raised dots. The back of the watch is brushed 14K gold and is suitable for engraving. These pieces are magnificent and would make a fine presentation for any occasion.

Please state wrist size, otherwise a standard length band will be furnished (men's 7 1/4", women's 6 1/4").

All models are attractively gift boxed. Weight: 12 oz.

Women's Presentation 14K

Automatic (self-winding) wrist watch with Florentine finish. Black leather band with gold-filled buckle. @
CM426—\$312.95

Women's Presentation 14K

Wrist watch with Florentine finish. Black leather band with gold-filled buckle. @
CM47—\$307.95

Men's Presentation 14K

Automatic (self-winding) wrist watch with Florentine finish. Black leather band with gold-filled buckle. @
CM36—\$424.95

Men's Presentation 14K

Wrist watch with Florentine finish. Black leather band with gold-filled buckle. @
CM37—\$377.95

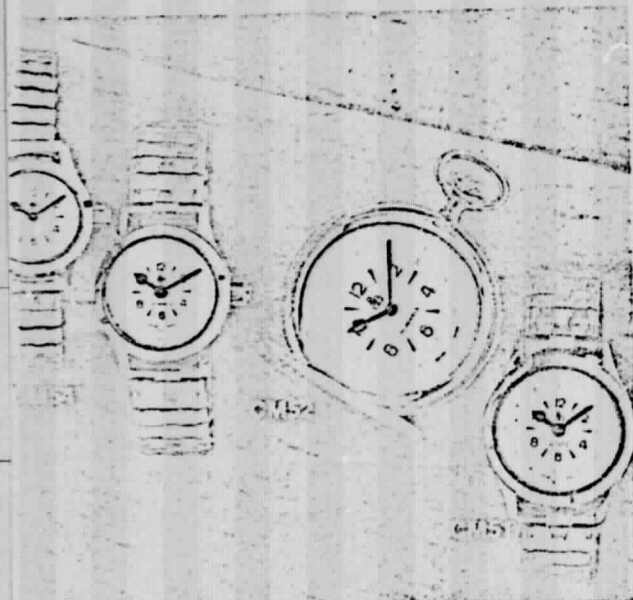
14K Gold Bracelets

Women's 14K gold bracelet with Florentine finish. Matches CM426 and CM47. @
CC387—\$287.95

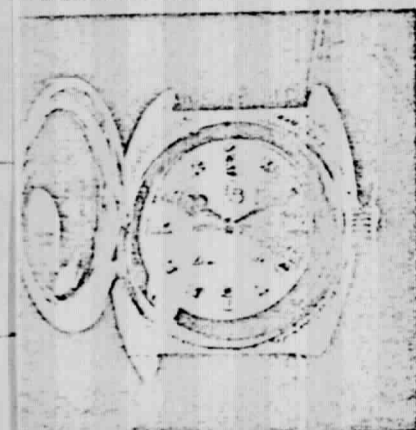
Men's 14K gold bracelet with Florentine finish. Matches CM36 and CM37. @
CC388—\$354.95

Note: State wrist size when ordering these bracelets.

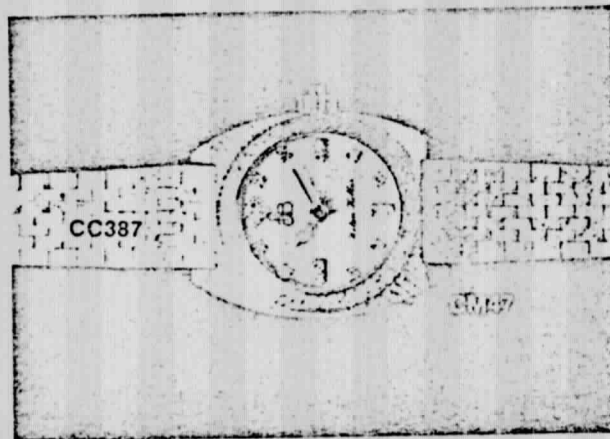
@ Braille instructions available on request. * Not shown



AFB Standard Watches



Men's Presentation Watch CM37



Women's Presentation Watch With Gold Bracelet